In re Patent Application of:
HILL ET AL
Serial No. **10/761,409**
Filed: **January 22, 2004**
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REMARKS

Claims 1 to 31 and 56 are currently pending. Claims 1 to 3, 7, 8, 16 to 18, 22, 23 and 56 have been rejected under 35 U.S.C. 102(b) or 35 U.S.C. 103(a) as being anticipated by or obvious in view of the Journal of Applied Physics Volume 91, Number 1, pages 367 to 374, entitled "Luminescence from erbium-doped silicon nanocrystals in silica: Excitation mechanisms", by Kenyon et al. Claims 1 to 30 and 56 have been rejected under 35 U.S.C. 103(a) as being unpatentable over the Background of the Invention in view of Kenyon et al. and PCT Patent Application No. WO 02/061815 (Zacharias). Claims 22 to 31 have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite, and claim 10 has been objectd to due to the presence of an informilty. Claims 1 to 31 and 56 have also been provisionally rejected on the ground of nonstatutory obviousness-type double patenting, as being unpatentable over claims 1 to 10 and 32 to 37 of co-pending United States Patent Application No. 10/761,275.

A terminal disclaimer in compliance with 37 CFR 1.321(c) is hereby attached to overcome the obviousness-type double patenting rejection.

In addition, the claims of the application have been amended to overcome the objection to claim 10, the rejection of claims 22-31 under 35 U.S.C. § 112, of the Examiner and to better define the invention. In particular, the typographical error in claim 10 has been corrected, and claim 22 has been rewritten in independent form to include all of the elements of claim 1.

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With respect to the rejections under 35 U.S.C. § 102 and 35 U.S.C. § 103 the following comments are offered: First of all, it should be noted that there are several key differences between the present invention and the device disclosed in the Kenyon et al paper.

First, in the method described by Kenyon et al, erbium is implanted into the SiO_2 layer using ion implantation, thereby causing ion implantation damage to the SiO_2 layer; in the present invention on the other hand, the group IV oxide layer is "free of ion implantation damage". Second, in the Kenyon et al device, erbium will not be dispersed on the surface of the semiconductor nanocrystals, nor will erbium be distributed substantially equally through the thickness of the group IV oxide layer, as Kenyon et al's ion implantation step will distribute the erbium with higher percentages near the surface of the layer, not around the surfaces of the nanocrystals. Only after repeated implanting steps cause more and more damage, will the concentration profiles become flat, but even this will not ensure that the erbium is evenly distributed throughout the layer and on the surfaces of the nanocrystals. In contrast, the method according to the present invention provides simultaneous introduction of Si and Er material guaranteeing that the Er is distributed evenly and on the surface of the nanocrystals.

Finally, and perhaps most important, the present invention provides for an erbium concentration of between 0.5 and 15 atomic percent, while the Kenyon et al reference discloses an erbium concentration of 1.0 atomic percent.

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In *Atofina v. Great Lakes Chemical Corporation*, No. 05-1359 (Fed. Cir. March 23, 2006), the Federal Circuit reversed the determination that the JP `206 reference anticipated certain claims in the `514 patent based on an overlap in both the temperature range and the methylene chloride ratio range. The prior art disclosure of a preferred temperature range of 150 to 350 °C did not anticipate the claimed 330 to 450 °C range because "the disclosure of a genus in the prior art is not a disclosure of every species that is a member of that genus." The reasoning of *Petering* (a very small genus can be a disclosure of each species within the genus) did not apply here because a temperature range of over 100°C could not be considered a small genus. Similarly, the claimed oxygen/methylene chloride ratio of 0.1 - 5.0% was not anticipated by the JP `206 reference disclosure of a ratio of 0.001 - 1.0% because (1) the entire claimed range was not described with sufficient specificity; (2) the lower end of the ratio in the JP reference differed by a factor of 100 from what was claimed; and (3) the disclosure of a 0.001 - 1.0% range was not a disclosure of the end points of that range.

Accordingly, the disclosure in Kenyon of an erbium concentration of 1 at. % does not anticipate the disclosed range of 0.5 to 15 at. % according to the present invention. Moreover, claims 21 and 22 clearly define ranges of concentration outside the range disclosed in the cited reference. Furthermore, it is extremely difficult, if not impossible, to achieve a high concentration of erbium, as achieved by the present invention, with the method disclosed in Kenyon using ion implantation. Only the methods disclosed in the present application provide the high concentrations of

erbium, thereby producing a doped semiconductor nanocrystal layer, which is both novel and unobvious.

In general, the concentration of the rare earth element is preferably as high as possible, as the level of photo-electronic qualities of the film, e.g. photoluminescence, is proportional to the rare earth concentration. However, in prior art systems, such as the one disclosed in the Kenyon et al reference, a high concentration of rare earth material causes the rare earth elements to come in close proximity with one another, which results in a quenching relaxation interaction that reduces the level of photoelectronic dopant response. Accordingly, not only have prior art systems had difficulty in achieving high rare earth concentrations, they have had no real desire to achieve them, since too high a rare earth concentration has been found to be counter-productive.

However, in the system and method of the present invention, in which the rare earth elements are evenly distributed throughout the oxide layer and dispersed on or near the surface of the semiconductor nanocrystals, high concentrations of rare earth material are not only possible, but useful and desirable. Moreover, the evenly distributed rare earth elements dispersed on the surface of the semiconductor nanocrystals maximize the energy transfer therebetween.

Claim 24 has been amended to more clearly define the multi-layer structure of the present invention, which includes different rare earth elements in different layers, enabling either different colors to be turned on at different times, or

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a plurality of colors to be turned on together, thereby enabling a variety of combined colors to be provided.

In view of the foregoing, it is respectfully submitted that all of the claims remaining in the application are in condition for allowance. Early and favorable consideration would be appreciated.

Should any minor informalities need to be addressed, the Examiner is encouraged to contact the undersigned attorney at the telephone number listed below.

Please charge any shortage in fees due in connection with the filing of this paper, including Extension of Time fees, to Deposit Account No. 50-2810 and please credit any excess fees to such deposit account.

Respectfully submitted,

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CERTIFICATE OF FACSIMILE TRANSMISSION

I HEREBY CERTIFY that the foregoing correspondence has been forwarded via facsimile number 571-273-8300 to the COMMISSIONER FOR PATENTS, this 18 day of April 2006.

D. Kallemeyer